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METHODS FOR NASA-UNIVERSITY RELATIONSHIPS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION · WASHINGTON, D.C. ·

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Prepared by
NASA Task Group on Methods for University Relationships

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PREFACE

Since its inception, NASA has both sought direct assistance from universities for conduct of parts of the space program and tried to help strengthen the universities in the course of conducting the space program. This mutual effort to add to national strength has resulted in extensive and varied relationships with universities, their administrators, their faculties, and their students.

This report is intended to be a resumé, or catalog, with some commentary of the methods that NASA and its centers now use or reasonably could use in relationships with universities.

This compilation was requested by the NASA Office of University Affairs (appendix A) for several reasons. It is intended to assist the Assistant Administrator for University Affairs in his support of university programs; it should assist the Office of University Affairs in administering university programs for the agency; and it should assist the centers in initiating and managing university programs. The timeliness of this work is sharpened by NASA's declining budget and the subsequent impact on the support of advanced engineering, space sciences, and related subjects of education and research in the universities.

The required information and opinions were gathered by a task group comprising a representative from each center (appendix B). The charge to this Task Group was to develop and document the kinds of project, program, contract, grant, mutual agreement, mutual understanding, and other undertakings and arrangements that have been tried or could be tried in the conduct of NASA-university affairs. That is, the object was to assemble and document both past experiences and forward views of possibilities in the area of relations with universities.

The Task Group has, therefore, listed and illustrated every major type of activity NASA has had with universities. Each type of activity, or relationship, is described briefly and its purpose stated; the basic authority is listed and an example cited with a view that more information could thereby be found. Some background history is given, and the nature and extent of use of the activity in NASA is illustrated. Finally, for each type of activity, or relationship, a consensus of the Task Group members is offered on the general value, advantages, and disadvantages of the activity.

The hope is that in continuing NASA-university relations we will adopt the best from our past experiences, avoid the worst, and introduce promising innovations.

Walter T. Olson
John L. Anderson, Jr.
Editors

CONTENTS

PROJECT RESEARCH

Single Task Grants and Contracts

Purpose and description. - The traditional way in which the federal government relates to universities is through a grant or contract to support an individual or a group at the school in an investigation of a single concept, or phenomenon, or problem. The grant or contract most often results from an unsolicited proposal; the final form of such a proposal usually has been reached by informal discussions between the proposer and NASA staff. Research grants and contracts have served a wide variety of purposes, such as basic research, development of research equipment, making measurements, support of flight experiments, engineering services, and documentation of NASA history. Reference 1 describes these activities in general.

Authority and examples. - Public Law 85-568, July 29, 1958, 42 U. S. Code 2473 (b) (5), formerly the National Aeronautics and Space Act of 1958, as amended, Section 203 (b) (5) gives authority for single task grants and contracts. Policies and regulations are contained in NASA Grant Handbook NHB 5800.1 (Jan. 1970), for sale by the Superintendent of Documents. Numerous examples exist.

History and extent of use. - Virtually every office and center of NASA has sponsored work in this mode at some time or other since NASA was created. About 1300 project-oriented research grants and contracts are currently active in about 200 universities; fiscal year 1969 obligations were about $130 million. About 90 percent of support to universities is by project support. References 2 and 3 give a general discussion and a detailed listing of these activities.

Discussion. - Advantages to NASA include the obvious one of enlisting valuable talent on problems of concern to NASA's mission and the less obvious one of long-range strengthening of the entire national fabric of science and technology by the strengthening of the educational base.

Advantages to universities are that a grant or contract is an uncomplicated way to secure support for an individual or team on a project. Step-funding ameliorates termination. The usual direct, immediate interest of NASA's technical staff in a specific project is mutually advantageous. A disadvantage to the university is created if the amount of cost sharing is too great or if overhead exceeds reimbursement excessively. Another disadvantage may result if NASA personnel use university personnel as a "job shop". A major disadvantage is the inordinately long time taken by NASA to act on a proposal or a renewal.

Multitask Grants and Contracts

Purpose and description. - A variation of the single-task grant is a grant in a particular scientific area or discipline for work to be later described by the school and approved by the NASA technical monitor. For example, the Lewis Research Center has sponsored such grants. Within the scientific area specified by the grant agreement, both the Lewis staff and the university staff suggest individual tasks. After joint discussion and agreement, the technical monitor approves the selected individual tasks and then notifies the school and the contracting officer of his approval by distributing signed copies of the tasks. The school then proceeds with the research. Total time elapsed during the approval cycle can be less than 1 week. Semi-annual reports are required to generally review the progress made and the direction being followed in the foreseeable future. Annual reviews are conducted by the technical monitor; they take the form of formal presentations of the results by the principal investigator on each task. These reviews are held sometimes at the NASA center and sometimes at the school.

These grants have been step-funded and extended annually.

Similarly, Langley has two master agreement, cost-reimbursable contracts with local schools. They cover research studies, feasibility studies, breadboard construction of prototype equipment, and consultation. The use of Langley facilities is involved and is arranged on an ad hoc basis.

For these grants and contracts, costs are negotiated, with equipment and services to be provided by each party noted, and a monitor is assigned for each task order as it is defined and agreed upon.

Authority and examples. - 42 U.S. Code 2473 (b)(5) gives authority for multitask grants and contracts. Grant NGL 36-003-064 (1965) with Case Western Reserve University for Basic Research in Fluid Physics ($115,000 in fiscal year 1970) and grant NAS1-9434 (1969) with Old Dominion University Research Foundation are examples.

History and extent of use. - Lewis has used the multitask grant since 1965 and has extended the concept to Cornell University (NGL 33-010-042, High-Temperature Heat Transfer), California Institute of Technology (NGL 05-002-136, Turbomachines), and Massachusetts Institute of Technology (NGL 22-009-383, Propulsion and Power Generation). The annual level of these grants ranges from $50,000 to $115,000. Langley has multitask contracts as noted above, with the College of William and Mary (NAS1-9461) and with Old Dominion University and is negotiating one with the University of Virginia; the annual level is about $50,000. The Ames Research Center has executed grant NGR 05-020-420 with Stanford University for a cooperative program in the computational aspects of fluid mechanics. This grant is currently funded at an annual level of $60,000, with $80,000 obligated to establish step-funding: $50,000 for the first year of step-funding, and $30,000 for the second.

Discussion. - Grants of this type are selected on the basis of an outstanding faculty working in an area of direct importance to NASA, as compared to grants to individual investigators in a school. Therefore, a group of outstanding faculty members is available for conducting research under the grant. NASA obtains rapid response to those specific research problems identified under the scope of the contract. Each task is defined and approved in a matter of days. Thus, the researcher can get started before he is otherwise involved or loses enthusiasm. And the length of the period of support is not constrained. A mix of 1-year, 3-year, and 6-month tasks can be conducted simultaneously. A task can be stopped without hurting the overall support level of the grant. Often "strolls down blind alleys" are recognized early, and the work is stopped. Negotiation expenses are reduced.

Strong interactions of the technical monitor and NASA staff with the faculty and students have been mutually advantageous.

On the university side, the schools orient their research to meaningful problems and have a very useful mechanism in the use of NASA facilities, as needed. The faculty can enlist top-quality graduate students because longevity of support is assured, a long wait for approval is avoided, and several faculty members are working on common problems. Also, the faculty group interacts internally and thus stimulates and motivates individual members of the group; the result is to help develop a first-class faculty team in a given scientific or technical area. Such broad development is very important to a small, developing school.

No disadvantages to NASA or to the universities have been perceived. The management and coordination required both at the university and at NASA are well compensated for in the effectiveness of the work.

The multitask grant or contract is very desirable in scientific areas which can benefit from a spectrum of related tasks being conducted simultaneously and under one technical monitor who is given some decision prerogatives by center management. Both the centers and the universities are very enthusiastic about this form of relationship.

Multidisciplinary Grants

Purpose and description. - A multidisciplinary grant to a university is intended to encourage faculty and students from several disciplines to work together for broadened understanding, to solve complex problems, to initiate new ideas, or to create new capabilities. Such a grant permits the university to pick and choose, usually through a steering committee, among aerospace-related studies proposed by various faculty members. Long-range objectives include development of capability for interdisciplinary problem-solving, stronger aerospace research competence, university concern with the technology transfer process, university involvement with community and societal problems, and capability for institutional response.

Authority and examples. - Authority for multidisciplinary grants is given by 42 U.S. Code 2473 (b) (5). Multidisciplinary Space Related Research in the Physical Engineering, Life, and Social Sciences, University of Cincinnati grant NGL 36-004-014, and Multidisciplinary Space-Related Research, Pennsylvania State University grant NGL 39-009-015, are examples.

History and extent. - A Sustaining University Program, including multidisciplinary research, was initiated in 1962. By fiscal years 1965 and 1966, about 50 universities were funded for multidisciplinary research projects at $11 million out of a sustaining university program of about $45 million; that program also included facilities grants and training grants. In fiscal year 1970, 25 universities were funded with $5 million for multidisciplinary research. The status of NASA's Sustaining University Program as of December 31, 1969, is described in reference 4; the presidential budget proposed for fiscal year 1971 does not include funds for continuing the Sustaining University Program.

Discussion. - Advantages to NASA from its support of multidisciplinary research have been in the development of people and in the creation of new capabilities for research and education (e.g., aerospace engineering, space sciences, and stronger astronomy). General knowledge in areas of interest to NASA has been expanded. Some applied studies pertinent to NASA missions have contributed useful results. New people and new ideas have entered the aerospace field. In general, however, there is considerable disappointment among NASA technical staff in the multidisciplinary grants program (ref. 1). Results of individual projects under it do not often find direct usefulness in NASA programs. Also, university personnel seldom make any effort to combine disciplines; social science involvement is slight and isolated from other science; and there is little innovation in universities toward a "systems approach" (multidisciplinary) on big, "real-world" problems. In other words, the long-range objectives, even when expressed in a Memorandum of Understanding accompanying a facilities grant, have generally not been ardently pursued, and the multidisciplinary grant is just used as a pot of money. Perhaps much tighter management by NASA would alter this picture, but the intention has been to let the university be the manager.

The big advantage to a university is the flexibility in funding faculty and graduate students on an individual basis. New ideas and new people have been supported with the seed money provided. Some universities have developed important areas of research strength, such as the research in remote sensing at the University of Kansas, bioengineering and sensory isolation at the University of Vermont, energy conversion at the University of Pennsylvania, and communications at the University of Southern California.

A big disadvantage to a researcher supported by a multidisciplinary grant is apt to be the lack of a counterpart of a contact in NASA. It is difficult to keep enthusiasm high for a space-related project when you can't find anyone in the space agency who is interested in it; maybe

someone is interested, but the contact may never be made. University administrators have, by and large, passed up the opportunities to direct a group of people from various disciplines against meaningful problems.

More contact with NASA staff, as in the case of a multitask grant, and more innovative management in the university would be valuable to the performance on a multidisciplinary grant.

TRAINING PROGRAMS

Off-Site Graduate Study

Purpose and description. - Employees who qualify on the basis of job performance, academic standing, and job relatedness of the academic program are encouraged and supported in off-site graduate studies. The studies may range from not-for-credit courses to pursuit of the master's or doctor's degree. Support may vary from graduate study leave to full salary and tuition. Time involved may vary from a few hours a week to full time.

A formal policy directive of NASA, NPD 3272.1, January 29, 1969, states that it is NASA policy to grant a leave of absence without pay for 1 year, renewable to a total of 3 years, to employees seeking advanced degrees or accepting full-time faculty or staff positions with institutions of higher learning. The policy is also designed to protect the job security and the promotion opportunities of such employees.

Authority and examples. - The Government Employees Training Act (formerly Public Law 85-507), Chapter 41 to Title 5, U.S. Code gives authority for off-site graduate study. Examples exist at all centers.

History and extent of use. - Since 1958, thousands of NASA employees have received some graduate education in this program; many have received advanced degrees. For example, during the period fiscal year 1960 through 1969, approximately 18,834 employees completed graduate level courses involving a large number of colleges and universities. During the period fiscal year 1966 through 1969, approximately 459 employees were on long-term training over 120 days. During the period fiscal year 1964 through 1969, 147 employees earned doctorates, 644 earned master's degrees and 12 earned bachelor's degrees.

Since 1963, Ames has had over 300 employees who studied for advanced degrees in universities. Fifty-eight received master's degrees, 2 received engineering degrees, and 9 received doctorates. At present, 110 employees are participating in the off-site graduate training program. Five are attending a university on a full-time basis (1, Stanford University; 2, the University of California at Berkeley; and 2, York University, Ontario, Canada).

Kennedy Space Center has approximately 300 employees participating in graduate programs; 88 of these have earned master's degrees.

Since the inception of this program, Langley employees have received 79 doctorates and 444 master's degrees from 46 institutions. In fiscal year 1970, Langley had 413 employees in the graduate program and 90 in undergraduate programs.

Discussion. - NASA, of course, derives better trained and more competent employees from this program. These opportunities for graduate training are an important factor in retaining bright, young technical people in NASA. It is also an inducement in recruiting more highly qualified personnel. Universities serving large numbers of NASA employees have modified and created courses and programs to meet the needs of NASA. This stimulation to graduate education has been described in reference 1.

On-Site Instruction

Purpose and description. - Full-credit courses, short courses, seminars, and lectures are conducted by universities at NASA installations in order to update knowledge and skills or to develop new competence. Topics cover scientific, technologic, managerial, or administrative subjects. Courses may be either during duty hours, or not, or mixed. In at least one instance, a university has appointed and paid NASA personnel to instruct at a NASA installation during off-duty hours. In a few instances, courses contracted for by NASA have been held in classrooms of a school near the center in order to assure peace and quiet for the class.

Authority and example. - Authority is given by the Government Employees Training Act, Chapter 41 to Title 5, U.S. Code. Contract NAS3-13642 (Lewis with the University of Toledo, fall quarter, 1969) is an example.

History and extent of use. - Various instructional activities have been used since 1958. The following activities are typical:

Ames Research Center: Two courses in computer technology were offered in 1970 by Foothill College to Ames employees. The courses were conducted after normal working hours using Ames facilities as classrooms. Approximately 50 students (Ames employees and others) enrolled; the course was for credit if the individual so desired.

A television system will bring Stanford University classroom lectures to the Center on a real time basis. During the 1970-1971 academic year, the Ames Research Center will have four classrooms with four monitors. The Stanford School of Engineering will offer most of the engineering courses to the employees in the Honors Cooperative Program; students from nearby industry (Philco-Ford and Lockheed) as well as Ames employees will avail themselves of the system established within the center.

In all, 135 seminars from U.S. and foreign universities, industries, and government agencies were presented in 1969.

Goddard Space Flight Center: In 1969, a 12-month program of on-the-job training (6 months) and graduate-level classroom instruction (6 months) was conducted by George Washington University in systems engineering.

Kennedy Space Center: In 1969, four different colleges and universities used classroom facilities at the center outside of normal working hours for both credit and noncredit courses. The University of Florida provides graduate level engineering courses via two television channels and two talk-back telephone circuits in classrooms at the center. Florida State University provides faculty, reimbursed under the Training Act, for an M.S. program in management, and the center library maintains 741 volumes from FSU primarily for use in this program.

Langley Research Center: Sixty-three Langley employees have been designated by various schools as graduate instructors. Some of these people are now teaching credit courses to over 200 employees. The graduate program in acoustics conducted by George Washington University will begin in September 1970 at Langley.

Lewis Research Center: Graduate engineering courses have been given at the center by faculty of the University of Toledo since 1962; seven courses were offered in the 1969 fall term. A seminar of seven lectures by management experts was given to center managers in classrooms rented at Baldwin Wallace College. Adjunct professors appointed from center staff served as advisers for on-site thesis research by other NASA personnel (North Carolina State College; University of Toledo). Center personnel appointed and paid by John Carroll University as instructors conducted courses on site during off-duty hours; initially, class members were reimbursed for tuition, but more recently the project has been a contract to JCU.

Manned Spacecraft Center: The Clear Lake Graduate Division of the University of Houston offers a set of courses to students in engineering, mathematics, the sciences, and management at the Manned Spacecraft Center. In 1969-1970, approximately 32 to 35 courses were offered over a 3-semester period; about 125 members of the professional staff of MSC and a like number from support contractors enrolled each semester.

Marshall Space Flight Center: Since 1960, complete graduate curricula leading to appropriate degrees in engineering, mathematics, and the physical sciences have been offered by the University of Alabama at Huntsville. Classes are conducted on the UAH campus located just outside the MSFC. In fiscal year 1970, 314 Marshall staffers were enrolled in graduate courses; in the last 8 years, 2341 employees received graduate training. Sixty to 120 different graduate courses are

taught each year. To date, 26 doctor's and 149 master's degrees have been earned.

Hundreds of MSFC people attend 12 or more space science seminars each year conducted by outstanding educators and researchers from all over the world, including such people as Dr. Harold Urey, Dr. James Van Allen, and Dr. Christian Barnard.

About 30 people are enrolled in 1970 for undergraduate study.

On-site noncredit short courses from universities, other institutions, and industry are attended each year by more than 2000 MSFC employees. (An average of eight universities per year conduct these courses.)

MSFC employees at remote locations and those away for full-time graduate study give us a working relationship with 45 universities.

Discussion. - The Government Employees Training Act allows, and NASA exercises, wide latitude in the way in which training can be provided to the staff. An advantage of on-site training to NASA is that training either to update or to learn new knowledge is greatly facilitated; both real and psychological barriers of traveling to a campus and of struggling with time schedules are largely eliminated. Also, of course, material can be adjusted to meet NASA's needs. Advantages to universities are that their base of support is broadened, their faculty is put in close touch with current technical needs, and some excellent scholars are brought into advanced-degree programs. There is some inconvenience to faculty members in traveling away from campus. Some schools have been unwilling to put their academic blessing on activities conducted outside their ivied walls. But where both a center and a university have put even a modest mutual effort into a training program, the results have been exceedingly gratifying to both parties.

FACULTY PARTICIPATION AT CENTERS

The opportunity for faculty or postgraduate students to become members of the NASA "work community" facilitates the exchange of information between NASA and the university. Faculty participation at centers may occur through any of several arrangements which are either jointly administered by NASA and a university or nonprofit agency, and involve fellowships and associateships, or are solely administered by NASA through some form of employment.

Each arrangement has basically the same purpose, but each is different in method in order to exploit some particular feature. The purpose of these programs is twofold: to broaden and deepen the technical expertise of the universities by exposing the faculty to NASA activities and to obtain specific technical support for these activities from the faculty members.

In general, all these arrangements for faculty participation offer the same advantages and disadvantages to NASA and the university. NASA benefits by acquiring the participant's professional input, by broadening the professional knowledge base of the participants and their institutions, and by increasing interest in space research which can be then transmitted to students - who are future researchers and recruits. Another advantage is the formation of additional communication links with universities which aid in recruiting, public relations, technology utilization, and the broadening of NASA's base of technical information. The only disadvantage to NASA is the usual - money.

The university benefits from the upgraded and updated faculty experience and the subsequent revision or introduction of curricula, courses, lectures, experiments, or research. Furthermore, the experience that gives rise to the university benefits is often acquired during the university "slow season" - the summer. In addition, faculty members have an additional source of income.

Further advantages or disadvantages of a particular arrangement for faculty participation will be discussed below.

Fellowships

Purpose and description. - In cooperation with the American Society for Engineering Education (ASEE), the Summer Faculty Fellowship Program in space-related research was initiated in 1964. These programs are carried out cooperatively between NASA centers and one or more nearby universities. ASEE announces, publicizes, evaluates, and makes recommendations to NASA on programs. The objectives are to further the professional knowledge of the teacher, to stimulate an exchange of ideas between participants and NASA, and to enrich and refresh the research activities of the participant's institution.

Grants for support of the Summer Faculty Fellowship Program are made to the university which, in cooperation with the NASA center, selectes young faculty members to participate. The program has two major divisions: engineering systems design, where the fellows form a multidisciplinary team which then selects and designs a complex system, and research, where each fellow works on research projects of mutual interest to himself and the center.

In the research program, each fellow works in his own field with a center colleague, but with no disciplinary linkage with the other fellows at the center. The research program consists of some combination of academic program (lectures, seminars, and workshops organized by the sponsoring universities) taking 10 to 20 percent of the time and a research assignment taking 80 to 90 percent of the time.

In another fellowship program, a unique summer course in a frontier area of knowledge has been offered. At the Summer Institute in Astronomy and Astrophysics (sponsored by the Goddard Institute for

Space Studies and the State University of New York at Stony Brook) the fellows consider all important aspects of one main topic - some phase of theoretical or observational astronomy.

A fellow is usually selected for one of several reasons: (a) because he is at an early stage in career development; (b) because he is in a school not already heavily engaged in aerospace research but able to use his experience either in research or curriculum development; or (c) because he is capable of participating fully in a center-managed research project.

Authority and examples. - Authority is given by 42 Code 2473 (b) (5). There are numerous examples of the NASA-ASEE Summer Faculty Fellowship Program.

At Langley, under contract NSR 47-003-010 with Old Dominion University, the faculty participants in the engineering systems design program have been selected from a variety of disciplines; the political, sociological, economic, geological, chemical, education, and engineering sciences. The group has so far produced design concepts for educational TV and Earth resources survey systems.

At Ames, contract NSR-05-020-088 with Stanford University provides a Summer Fellowship Program in aeronautics and space research; similar contracts exist at seven other locations, as described below.

The GISS-SUNY/SB Institute was supported by the University in 1967 as an experimental project; it is now supported under NASA grant NGR-33-015 (077).

History and extent of use. - The program was initiated in the summer of 1964 at three NASA centers in cooperation with three nearby universities to provide summer fellowships for 45 young faculty members. Through the summer of 1969 about 1125 young faculty from over 225 colleges and universities participated in the research program at nine NASA centers. About 225 young faculty from 50 colleges and universities participated in the engineering systems design program at four NASA centers.

The following programs for about 350 young faculty were active during the summer of 1970:

Engineering Systems Design

Marshall Space Flight Center	Auburn University
Ames Research Center	Stanford University
Langley Research Center	Old Dominion College
Manned Spacecraft Center	University of Houston
	Rice University

Aeronautics and Space Research

Ames Research Center	Stanford University
Marshall Space Flight Center	Auburn University
	University of Alabama
Jet Propulsion Laboratory	University of Southern California
Manned Spacecraft Center	University of Houston
	Texas A&M University
Langley Research Center	Old Dominion University
Lewis Research Center	Case Western Reserve University
Goddard Space Flight Center	University of Maryland
	The Catholic University of America

Discussion. - The fellowship programs have resulted in the development of new courses and modifications to established ones; participants have arranged consulting situations with the centers, and many have obtained grants and contracts from NASA and other federal agencies.

The engineering systems design concept has been highly effective in stimulating student innovation and in teaching the application of engineering theories to actual engineering problems.

An important function of the GISS-SUNY/SB Summer Institute has been to expose young astronomers and graduate students in astronomy to ideas and techniques in many different areas which they cannot get in the average small astronomy department.

Associateships - National Research Council

Purpose and description. - A program for resident associates provides an opportunity for faculty members or postgraduate investigators from the United States and foreign countries to perform or participate in advanced research in space-related science and engineering. The program is supported by a NASA grant and is administered by the National Research Council under the National Academy of Sciences and the National Academy of Engineering. Associates are selected because of their established expertise in a specialty of importance to NASA.

Authority and example. - Title 5 - Code of Federal Regulations (Administrative Regulations) Schedule A, Sec. 213.3102 (AA) gives authority. Contract NSR 09-012-087 with the National Academy of Sciences (1970) is an example.

History and extent of use. - Since the beginning of the program at GSFC in 1959, appointments have been held by 633 associates, from 39 countries, at 7 NASA centers and GISS. Between 1962 and 1968 more than 60 percent of the associates came from 28 foreign countries.

On February 28, 1970, 184 scientists who were in this program were distributed among NASA centers as follows:

Goddard Space Flight Center	43
Goddard Institute of Space Studies	12
Ames Research Center	49
Marshall Space Flight Center	13
Langley Research Center	14
Manned Spacecraft Center	22
Jet Propulsion Laboratory	20
Electronics Research Center	11
	184

Discussion. - Associates are chosen on the basis of being able to pursue advanced work on a particular topic of their choice. Appointments can be made for periods extending from a summer to a year and are renewable.

NASA benefits by having the additional expertise present in the field installations. The scope of work is increased; important problems are solved; the staff is stimulated. In the case of foreign associates, the program is valuable as a tool to enhance international understanding in the scientific community. A disadvantage to NASA could occur if NRC is unable to match the selection priorities that have been established by NASA; selection affects the types of research that can be conducted.

Associateships - NASA Research Grant

Purpose and description. - A research grant to a specific university provides for a faculty member to conduct research at a NASA center during a sabbatical or postdoctoral year. The research must be on a problem of mutual interest to a university department and to a center organization.

Authority and example. - Authority is given by 42 U.S. Code 2473 (b) (5). MSC has a research grant in biomedicine with Baylor College of Medicine. On this grant one postdoctoral researcher is assigned equipment in MSC's $3 million Clinical Biochemistry Laboratory (including an ultramicrospectrophotometer and an electron microprobe).

History and extent of use. - MSC has used the award of a grant to bring university researchers (either on a postdoctoral or sabbatical year) to MSC in order to make available to them in the conduct of their work facilities, equipment, data, etc. that are (1) located at the center, (2) unavailable at the university or impractical to move from the center to the university, and (3) necessary for conduct of the research. Only four have been issued to this date.

Discussion. - The main advantage to NASA is that an expert from a university faculty can be given funds for a research project that involves the use of a highly specialized and unduplicable piece of equipment or a large volume of data that is unavailable except at a specific NASA facility. The advantage to the faculty person is obvious. The success of this arrangement has yet to be determined. Four individuals are working on projects that are of mutual interest to MSC and to a university, using unique MSC facilities, equipment, and data.

The advantage to accrue to the university must wait until the faculty member resumes his university position. There is no doubt that the interchange between the university individual MSC and the university staff has continued while the individual is working on his project at MSC. The use of their mechanism is too new to permit evaluation of the university benefit.

Employment

Purpose and description. - NASA hires faculty members either parttime as (1) consultants , or fulltime as (2) short-term (often summer) employees, (3) project-term employees, or (4) long-term (usually 1-year renewable) employees.

Consultants, who add their expert knowledge and their perspective to NASA research or management areas, serve either on a periodic basis or as the need arises. The purpose of hiring short-term employees is both to acquaint them with the activities and mission of NASA and to utilize their experience and new perspective. This employment is on an individual basis and is conducted solely by NASA in contrast to the fellowship program, which provides support for many teachers under a "blanket" grant. Project-term employees are expected to make a substantial contribution on a given project or perform specific research of particular interest to NASA using NASA facilities. Long-term (but still temporary) employees may be hired for their technical or specialist skills.

Authority and examples. - Authority for consultants is given by 42 U.S. Code 2473 (b)(9) and 5 U.S. Code 3109, 42 U.S. Code 2473 (b)(4), or CFR Schedule A, Sec. 213.3102 (b). Numerous examples exist. For instance, MSC employed faculty members as temporary consultants for a summer program in administration and management; the program is project-oriented. Authority for short-term employees is given by CFR Schedule A, Sec. 213.3102 (0). There are numerous examples. Authority

for project-term employees is given by CFR 316.302 (a)(b)(c). Authority for long-term (but temporary) employees, not for a specific project, is given by CFR 316.402 (a).

History and extent of use. - The hiring of consultants and short-term employees is a well-practiced method of obtaining faculty participation in NASA Headquarters and center activity. At ERC, a Summer Employment Program is in operation during the period from May 15 to September 30 each year. College students and faculty members from high schools and colleges are assigned temporary positions at ERC to gain work experience on NASA programs. During fiscal year 1969, 79 such allocations for students and faculty were made.

KSC hires (excepted appointment - temporary) six to eight faculty members each summer to work on specific projects. An example of a project carried out during the summer of 1969 was an Evaluation of John F. Kennedy Space Center's Support Service Concept and Contractual Arrangements Related to Providing Support Services. No other type of employment of faculty is involved.

Discussion. - Consulting is distinct from the other forms of faculty participation because residence at the center is not necessary. The short- and long-term employment provides additional means of exchanging information, attitudes, and spirit between NASA and the university faculty.

Project-term employment provides a flexible economic means of solving technical problems and permits more effective use of NASA equipment and facilities. On the other hand, it is more costly to write a grant or contract for each individual research situation.

Reciprocal Agreement

Purpose and description. - A modification to a Basic Reciprocal Agreement with a specific university provides for a faculty member to conduct research or perform related duties within a defined scope of work on a problem of interest to the university's personnel and the center.

Authority and example. - Authority is given by 42 U.S. Code 2473 (b) (6). At Marshall, under a modification to the Basic Reciprocal Agreement with Auburn University, a faculty member is engaged in a project for determining methods of disseminating NASA Systems Approach Technology in the Training of Design Engineers.

History and extent of use. - Marshall has used this method in the instance cited above. This agreement was effective as of October 6, 1969, and the project terminated on June 15, 1970.

Discussion. - The principal benefit to NASA is that a highly qualified faculty member can be engaged to work on a project of mutual interest to the university and the center. The university, in this particular case, gains benefits of a "feedback" of information and technology which is useful not only in classroom application but also in university and/or departmental management areas. For the faculty member there is the advantage of an increase in awareness. From his personal point of view, there is the acquisition of information which is useful in his publication efforts.

The main disadvantages are identification of projects of mutual interest and the problem of availability of funds to support such endeavors.

STUDENT PARTICIPATION AT CENTERS

Cooperative Training Program - Civil Service

Purpose and description. - The purpose of this "classic" method is to introduce undergraduate students into the work force and provide on-the-job training that will supplement their academic knowledge. The students combine regular periods of employment at a NASA center with alternate periods of study at their universities. Fields of interest have included engineering, physical science, law, business administration, and journalism.

Authority and example. - CFR Schedule B, Sec. 213.3202(a) gives authority for the program. Numerous examples exist.

History and extent of use. - The method is widely used. At the present time, 133 universities have co-op programs, 58 of which began within the past 5 years. During the past few years, ERC has conducted a Cooperative Education Program with Northeastern University. Undergraduate students in science and engineering attend classes at NU for about 13 weeks and then come to ERC for a similar period for work assignments in their field of interest after having completed their initial three quarters of continuous class work at NU. Salaries of co-op students are based on ratings assigned by the Civil Service Commission on the basis of their academic level. During fiscal year 1969, two groups of 13 students each were alternating in attendance at ERC, making a total of 26. KSC has a co-op program with 14 institutions and, for 5 years, has had an average of 43 co-ops per year enter the program. MSC has 16 to 17 schools actively involved in providing approximately 70 students to the co-op program. All are in science and engineering areas. Most are from four schools - Houston, Cincinnati, Georgia Tech., and Texas A & M. In 1965-1966, the program was at a manpower strength of 240. MSFC has 169 pairs of co-op students from 25 colleges and universities. The retention rate of graduates has varied from 85 percent in 1963 to 27 percent in 1969. The low retention for 1969 is due to our reduced manpower ceiling and the fact that we were

not in a position to aggressively recruit the co-op graduates. In 1969, Langley had 87 co-op students. Ames employs 50 to 60 students during the summer. In 1967, MSFC had the largest co-op program in NASA - 287 students from 20 universities in 12 states.

Overall in 1967 NASA employed 840 co-op students from about 60 colleges and universities; this was down from the 1115 employed in 1966. More than 95 percent of the students were in science and engineering; the rest were in administrative areas. More than 50 percent of those graduating have been employed by NASA.

Discussion. - The co-op program benefits students and NASA alike. Some advantages are tangible; others, less readily measured, are long range. The advantages to NASA are that the co-op student can more nearly earn his salary when he begins his professional employment; he also serves as a contact with the faculty and other students. He can be thoroughly grounded in "real-world" practices while he is still at the formative level. However, the lack of experience and limited academic background of the co-op student initially require more of the NASA supervisor's time to make him productive than is the case with regular employees.

The advantages to the university and the student are (1) up-to-date experience of the co-op student, which can be brought into the classroom, (2) accommodation of more students with the existing physical facilities, (3) maturity and discipline acquired by the co-op, (4) easier placement of co-op graduates because of their work experience, and (5) financial assistance to the student. However, because of the alternate work-study periods, the university must more carefully plan and conduct its academic course offerings on a year round basis.

The co-op program is a form of undergraduate scholarship. For example, Auburn University has 800 students with average earnings of $3500 each or $280,000.

A variation called part-time co-op, in which a student works only part-time during the academic year, has been conducted at Goddard Space Flight Center and the University of Maryland since October 1968. It has a disadvantage in that it is less efficient than the "classical" full-time co-op programs because a co-op ceiling point is used for a student who is at Goddard half time all year instead of two students each at Goddard full time for a half year. Because of this disadvantage, the program is being switched over to the "classical" co-op program.

Cooperative Training Program - Office of Economic Opportunity

Purpose and description. - This program provides useful work experience for disadvantaged students, both undergraduate and graduate. They are paid by the university for work done at the NASA center. The

program can consist of formal training lectures, planned rotational work assignments, and comprehensive on-the-job training.

Authority and examples. - The Economic Opportunity Act of 1964, College Work Study Program, Sec. 141-145, Title 1C gives authority for the program. The university must have an OEO grant. The Goddard Space Flight Center - Federal City College Work-Study Program in Procurement is an example. The Langley Training Agreement is authorized by Sec. 210 (EOA of 1964)-42 U.S. Code 2790; part B of Title I (EOA of 1964) 42 U.S. Code 2731.

History and extent of use. - This type of program was first used at Ames in 1966. Ames has had various OEO Cooperative Training Programs throughout the years. The OEO Work Study Program now extends to the DeAnza Foothill College District with from 10 to 25 students participating. The University of Santa Clara, Stanford University, and San Jose City College have participated in the past; however, it now appears that the OEO federal funds now received by these institutions are spent in fulfillment of on-campus work requirements.

Goddard has a program with Federal City College for training in procurement and a program with Bowie State College for training 15 students as technicians and scientific aides. These programs are also used at MSFC, Langley, ERC, and Headquarters. Langley has an arrangement with the College of William and Mary for studies by 6 students in the law library.

Discussion. - Community relations were improved by establishing a meaningful rapport with a school, its faculty, and its students in a significantly disadvantaged community. GSFC increased the quasi-professional work effort of the students in the Procurement Division at no manpower ceiling cost to the center and at only 20 percent of the total salary cost. A broad advantage to NASA is that legally the students can perform nearly any kind of task. Student participation is limited to 15 hours a week when school is in session and 40 hours a week during vacations and between terms. Often the disadvantaged student needs more money than 15 hours a week can yield; also, transportation can be a difficult problem.

The college benefited from the "real-world" business experience for its students and from aid in establishing curriculum competence in the field of federal procurement. As in the "classic" co-op program, the college must pay special attention to class scheduling.

Summer Institutes

Purpose and description. - The objective here is to provide a special learning experience in a particular subject for top quality undergraduate students. The institute is conducted jointly by a NASA center and a university; the students may come from many universities - all over the nation in fact. The institute usually combines university

provided instruction with field trips or on-the-job experience at a NASA center, and thus college credits are offered.

GSFC and George Washington University sponsored a Summer Institute for Biomedical Research in Technology Utilization in the summer of 1969. This institute provided 10 senior engineering students the opportunity of participating in actual research projects based on selected technical problems in the biomedical field. The facilities of the participating organizations were at the disposal of the five teams of two students. Students were selected on the basis of exceptional problem-solving ability and an interest in medical technology. The Goddard Space Flight Center has sponsored a Public Administration Institute in 1968 and 1969 and is repeating it in 1970. This gives students studying public administration a chance to observe and work with NASA officials and to study the decision-making process in a governement research and development environment.

Summer Institutes in Space Physics (SISP) and Space Engineering have been held cooperatively by GISS and Columbia University. The principal activities of the Physics Institute are a course of lectures in space physics and problem solving sessions with staff members and teaching assistants. A field trip to NASA centers is also held. At its inception (1962), the SISP offered the only undergraduate summer instruction in the United States in astrophysics and atmospheric physics. Participants are selected on the basis of a national competition.

A variation of the Summer Institute is the Summer Internship Program at Lewis which provides 8 weeks of on-the-job experience for outstanding seniors and graduate students from one university. The university provides lectures and discussions on the subject matter prior to the summer work.

Authority and examples. - GSFC has the following contracts: contract NAS5-9945 to the University of Maryland for a Public Administration Institute, which involved 12 students and a faculty advisor, contract NSR-09-010-035 to George Washington University for the Biological Sciences Communication Project for the Summer Institute for Biomedical Research in Technology Utilization, contract NAS5-21233 to Bowie State College for a Summer Institute in Computer Programming, for 12 students from 10 colleges. Lewis, under 42 U.S. Code 2473 (b) 5 has NASA grant NGT-33-015-099 with the State University of New York at Stony Brook (1969).

History and extent. - The Biomedical Institute at GSFC and the Internship Program at Lewis were first conducted in the summer of 1969; they are being repeated in 1970. The Public Administration Institute at GSFC was offered in 1968 and 1969. The physics program at GISS/Columbia has been offered since 1962. The engineering program was offered in 1964, 1965, and 1966. From 1962 to 1969, applications for the physics program were received from more than 300 colleges and universities; 132 schools have had participants; 407 American and 59 foreign students have participated.

Discussion. - NASA benefits from these Institutes in general by arousing interest of outstanding students from many schools to do graduate study or seek careers in space-related research, by obtaining the student's perspective on projects and programs, and by having the participants arouse interest in other students and faculty when they return to campus. Also, Civil Service complement ceilings do not apply to these educational projects.

In 1966, letters were sent to 209 SISP alumni questioning them regarding the impact of the summer program on courses of study and research interests. The study was limited to American students majoring in the physical sciences. Replies were received from 174 alumni, or 83 percent of the total. These replies indicated that 56 percent of SISP alumni were strongly influenced by the summer program in their choice of careers or fields of study. For most, SISP defined a specific field of interest within the space sciences. Others credited the program with awakening an interest in astrophysics or geophysics which had not previously existed.

As with all student programs, a major commitment of center personnel is involved. The personnel selected for guiding the students should be the "cream of the crop," and they are usually already overworked.

Universities benefit from the exposure of the student to the "real world" of space-related R&D and from the increased insight into the relative merits of their own programs. The cosponsoring university gets to introduce a new course into its curriculum. The Internship Program requires that special faculty time be given to the participants just before vacation starts.

With rare exception, the overall evaluations of the Summer Institute as a vehicle for student participation ranges from very good to remarkable. In all cases, continuance was highly recommended.

Graduate Research

Purpose and description. - The objectives are to provide financial and technical support of space-related graduate research. Through use of research equipment and facilities at NASA centers, the flexibility and breadth of the university graduate program can be increased considerably. Coupling this with the vast reservoir of NASA expertise in space-related R&D, a strong extension of university research is formed.

There are several ways in which graduate research is supported. One way is to provide a research or training grant to a university which can support several predoctoral research assistants and perhaps a full-time research associate or a seminar series. Often a NASA scientist serves as an adjunct professor of the university and is thus the student's dissertation adviser.

Another way is simply temporary employment of graduate students.

Still another way is to bring graduate students from several schools together under a fellowship program which may be administered by a single or by several participating universities. This program can be for thesis-level research or for a "Summer Institute" program.

There is still another "twist" in the technical support of graduate research in a project which does not involve student residence at the center. MSC in cooperation with Louisiana State University is giving six students an engineering design problem to be pursued on campus. MSC sends one employee for one semester of graduate study to LSU at the same time. In effect, this employee will be available to work with the students and to give advice and direction.

Authority and examples. - The following typical grants are for graduate research: GSFC grant NSG-695 to the University of Maryland (1965), Langley grant NGR 34-002-035 to North Carolina State (1968), MSC contract NAS9-10464 with LSU coupled with graduate study for one employee, Headquarters grant NGT-05-020-361 to Stanford, and Ames grant 05-020-233 to Stanford. Graduate research may also be supported by Civil Service temporary employment, for example, the temporary employment by MSC of individuals selected by graduate departments of eight universities.

History and extent of use. - The program is widely used. Each center may have arrangements with several universities. The use of fellowship programs is in general more recent (MSC since 1966) than the use of research or training grants (since 1960). The MSC-LSU Graduate Engineering Practice was offered for the first time in January 1970. At Ames, five graduate students in aeronautics are supported by a grant from the Office of University Affairs and will use Ames facilities for thesis work. Another Ames grant supports eight to ten graduate students using Ames facilities for collaborative research on cardiovascular dynamics and bone elasticity.

Discussion. - Doctoral students provide a continuing new source of ideas and perspective. This support is an excellent staffing device in that NASA and the student can observe each other's work before "hiring time." It assures training of a number of students in fields of interest to NASA.

The university is provided with sufficient support to develop some program in space-related R&D. Faculty and students have an opportunity to participate directly in space research without a requirement that the university develop the large technical support activities normally required. Support for an extensive seminar program or for a Visiting Scientists Program is provided; however, students must spend substantial time off campus, thus decreasing student-faculty interaction. And for the Collective Fellowship Programs, such as the Summer Institute, overall coordination is essential.

COOPERATIVE AGREEMENTS

Master Agreements for Reciprocal Use of Services, Personnel, and Facilities

Purpose and description. - In several instances, a NASA center and a university have concluded an agreement whereby the two parties make reciprocal use of each others services, equipment, personnel, and facilities with only limited exchange of funds. Such agreements contain the basic legal, administrative, and financial details for joint center-university cooperative endeavors. These agreements permit NASA employees to monitor courses at the university without cost, or to teach at the university or to organize and direct work such as a computer center as part of their official NASA duties. On the other hand, the university is offered free access to consultation, to the library, and to laboratories and other facilities on a "reasonable" basis. Additionally, equipment may be loaned to the university to support research activities there. Direct out-of-pocket expenses incurred by the university may be reimbursed for projects mutually agreed to and requested specifically by the NASA center. These agreements also call for the center to provide useful work experience to students in the Federal College Work-Study Programs, with part of the cost being paid by NASA and part via the university by Economic Opportunity Act funds. For example, in the agreement between Ames and Santa Clara University, 19 different joint projects involved 17 faculty members and 35 student assistants in 1969.

Authority and example. - Cooperative agreements are authorized by 42 U.S. Code 2473 (b)(6) and by Title 1-C of the Economic Opportunity Act of 1964, as amended, 42 U.S. Code 2751 et seq. The NASA-Ames/Santa Clara University Aerospace Institute Agreement (Reference Ed-Consortium), effective April 21, 1970 (22 pp.), is an example.

History and extent of use. - This type of agreement was pioneered by the Ames Research Center in 1966. Ames has also executed agreements with the University of New Mexico and Iowa State University. Goddard Space Flight Center has an almost identical agreement with Bowie State College, Federal City College, and the New Mexico Institute of Mining and Technology.

An MSFC agreement with both Mississippi State and Louisiana State Universities provides for faculty and students to use highly specialized facilities and equipment at the Mississippi Test Facility for research on projects of mutual interest. The research is funded through both multitask project grants and the SUP awarded to both universities. Facility and equipment usage is on a "noninterference" basis, and technician support, as required, is provided during off peak periods so as not to create an expense to the agency. An MSFC agreement was entered into with the University of Kansas whereby a Marshall employee was assigned to the university for one semester to serve as a faculty member in the area of systems design. An MSFC agreement was entered into

with the Alabama A&M University, a local ethnic institution. The Center was responsive to an urgent need on the part of the university to create an operational and instructional center focused upon a newly acquired computer. The services of an employee well qualified in the computational area were made available for three semesters. In addition, services of others on a consultant basis were made available as required.

Discussion. - The advantages to NASA of agreements such as Ames, Goddard, and Marshall have executed are that, once negotiated, they provide a rapid and simple mechanism for joint efforts with universities. Reaction time in initiating projects is minimal. Funding of the university's costs in joint efforts is straightforward and independent of the normal procurement system. Work-study programs for faculty and students help reinforce NASA work with no increase in complement. Relationships with bright enthusiastic faculty and with good graduate students are intensified. The use of the Mississippi Test Facility for university research helps to implement the agency policy of alleviating the economic impact created by curtailed activity. Disadvantages may include more "togetherness" with a university than center management really wants, in that interests of personnel may be too diffuse and uses of equipment and manpower too loosely managed to meet center objectives rapidly and efficiently. Management attention must be given to seeing that these agreements are not abused.

Universities gain from these agreements by having opportunities for faculty and students to participate in state-of-the-art projects. Major facilities become available to the university for legitimate academic purposes. Reimbursement for out-of-pocket costs on joint ventures of interest to NASA assists the financing of education. A mechanism for helping to implement the work-study provisions of the Economic Opportunity Act is created. There are obvious benefits to our society if a school like Alabama A&M University can be assisted to a higher level of competence. On the other hand, if campus and center are not geographically close, personal inconvenience can deter good faculty people from proper participation.

Overall, centers using a master agreement report that participants, both from the center staff and the university faculty, are highly enthusiastic about the relationship.

Agreements on Specific Projects

Proposed description. - Ad hoc agreements between a NASA center and a university can be made, with formality as little as an oral arrangement or a memorandum or letter of agreement.

Authority and examples. - Authority is given by 42 U.S. Code 2473 (b)(5) and (6). An example is the Memorandum of Agreement between Manned Spacecraft Center and the University of Houston to mount a weather measurement system on the University's transmitter tower. Another example is the execution of a License to Use Personal Property,

MSFC Form 3334 (Oct. 1969) (7 pgs.) in agreements between Marshall Space Flight Center and the University of Denver and others.

History and extent of use. - A common informal agreement on the part of NASA centers is to loan equipment to a university (numerous examples), or to contribute difficult-to-obtain supplies in support of NASA or other federal grant programs (e.g., liquid helium from Lewis sent to the University of Cincinnati). In the example cited, Manned Spacecraft Center can mount its weather profile measurement system at up to 600 feet above the ground without building a separate tower; data from the system will be provided to the University of Houston which wants them for use in studies of air pollution.

The Marshall Center has executed formal licensing agreements for loans of equipment to the school with Alabama A&M, the University of Arizona, the University of Alabama, the University of Florida, the University of South Florida, Grambling College, Memphis State University, South Dakota School of Mines and Technology, Talladega College, and Tuskegee Institute.

Discussion. - While most agreements are mutually advantageous to the two parties, often the government installation acts in the role of the rich uncle, loaning equipment or giving service or expendable supplies that it will not really miss very much, but recognizing that it is helping some university project enormously.

DEVELOPING INSTITUTIONS PROJECT

Purpose and description. - The purpose of this program is to provide new avenues for NASA to relate to the colleges and universities which serve predominately minority student bodies, the premises being that NASA has resources in terms of personnel, facilities, and funds which can be of assistance to the development of these schools and that these schools have resources which can support the national space program. The main thrust of the project is to establish small research grants at these schools in areas of interest to the nearby NASA center.

The project was initiated by awarding a small grant to a "lead" school to develop a catalog of research competences of the neighboring schools. Faculty interested in research were then asked to submit resumés. They were encouraged to visit the field center to discuss research interests with appropriate NASA personnel. When mutual interests were discovered, faculty and NASA center personnel were encouraged to arrange future meetings to draw up a research proposal. Bona fide proposals were then submitted to the Office of University Affairs for competition among potential investigators from similar schools.

Authority and example. - Authority is given by 42 U.S. Code 2473 (b)(5). Morgan State College, for example, under grant NGR 21-025-001, An Appraisal of the Capabilities of Developing Institutions in Maryland, Delaware, and Pennsylvania to participate in the University Research

program of NASA, provided support for Questionnaires, analysis, transportation, travel expenses of principal investigators and interested faculty from all schools participating.

History and extent of use. - The programs were started in the summer of 1968 with one lead institution near each of four NASA centers designated to help match college capabilities to center programs. The four programs were

Lead institution	NASA center	Total number of participating colleges
Morgan State	Goddard	10
Hampton Institute	Langley	5
Alabama A&M	Marshall	9
Prairie View A&M	MSC	6

At Goddard, 44 faculty members expressed some interest, approximately 15 came to visit, and 11 submitted nine proposals. Eight of these proposals were funded in the first year. Projects were funded at Bowie State College, Delaware State College, Federal City College, Howard University, and Morgan State College. In all but one case, Goddard project money was used to supplement the SUP funds. Also, the joint agreement with Bowie State College (see section on agreements) derived from this effort, and additional cooperative agreements are being sought with other schools. A grant at Morgan State College is to develop a multimedia course in basic astronomy.

At Langley, it took an additional year of technical-level discussions before proposals were submitted for consideration. Four research grants have been awarded to North Carolina A&T State University. Additional proposals from Virginia State College, North Carolina Central University, and Hampton Institute have been submitted for consideration.

At Marshall, more than $1.4 million worth of proposals were submitted from seven of the nine schools in the program. Five proposals were of significant relevance to the space program to be funded. Grants were awarded to Alabama A&M College, Oakwood College, Talladega College, and Tuskegee Institute (two grants) for about $130,000 of total support, $55,000 of which is project money from the center.

At MSC, four schools responded by submitting 21 proposals for an approximate total of $375,000. Nine proposals were accepted for funding from three schools for a total of about $90,000.

Discussion. - A number of the proposals have been jointly funded between OUA and centers. Some proposals were initially totally funded from center resources, and a few that were initially jointly funded were totally funded by the center after 1 year.

An analysis of the project thus far indicates that it has brought some new competent, responsive talent to NASA's work and has helped broaden the base of participation in NASA activities. This broadened participation also helps to distribute some of the new knowledge and technology of the space program to a wider segment of society. A disadvantage is that sometimes a considerable amount of time is required to match faculty interests with NASA needs.

Faculty members are provided with the information necessary to submit research proposals. Grants provide funds for faculty and student time and for procurement of equipment. The project has helped update faculty knowledge and involve students in meaningful research. The importance of involving schools that serve predominately black students intimately in every aspect of our society, including our space effort, need hardly be stressed.

INSTITUTES AND CONSORTIUMS

Goddard Institute for Space Studies

Purpose and description. - The Goddard Institute for Space Studies was established as a New York Office of the Goddard Space Flight Center. It has a small permanent Civil Service staff of nine persons who work closely with neighboring universities to develop a maximum university contribution to the space science program.

Associations between GISS and New York area universities are an integral part of GISS operations and constitute the greatest single source of strength and vitality in the GISS program. The most important element in these associations is the fact that a substantial number of graduate students perform research in space sciences on GISS premises under the guidance of GISS staff who hold adjunct faculty appointments in New York area universities. These graduate students work as research assistants in the GISS research program and use their research as thesis material for the Ph.D. degree in their respective universities. GISS staff members who are adjunct professors also offer courses in space science in neighboring universities.

Authority and examples. - The institute is a field office of the Goddard Center and reports to the Space Science Directorate of that center.

GISS has established important contacts within five universities including Columbia, New York University, the State University of New York at Stony Brook, Teshiva University, and the City University of New York. Graduate students working with GISS from these universities are supported by NASA grants, for example, NASA grant NGL 33-008-012 to Columbia University.

For the most part, GISS-university associations are not arranged through formal or contractual agreements, but are based on informal

arrangements between individual members of the GISS staff and various New York area universities. (In this respect GISS operating arrangements differ from those of the Joint Institute for Laboratory Astrophysics (JILA) and the Smithsonian Astrophysical Observatory (SAO). Jila and SAO depend on close university associations, but the dependdence is through an institutional tie through a single neighboring university, the University of Colorado and Harvard, respectively).

GISS associations with these five universities are based on two critical elements:

The first is the series of faculty appointments for GISS staff members on a parttime or adjunct basis; these appointments enable GISS staff members to offer courses in space science in neighboring universities and to supervise the Ph.D. research of graduate students working in space-related fields.

The second is the series of grants made by the Office of University Affairs to universities in the New York area with whom GISS has important contacts. The funds provided by these grants are utilized principally for the support of graduate students working with GISS staff members as advisors on space-related projects.

History and extent of use. - GISS was established in 1961, and the objective was to yield to NASA the double benefit of accomplishing space science research objectives while simultaneously contributing to the training of Ph.D. students in the space sciences.

At the present time, 40 Ph.D. students are being supported by these grants, of whom 30 are performing research on the GISS premises. This group of students is an integral part of the GISS research effort. They constitute the junior professional group in the GISS program and make up 40 percent of the total professional science and mathematics capability in the GISS building.

During the academic year 1969-1970 10 courses were offered by GISS staff at universities in the New York metropolitan area. The courses are important because they enable GISS staff members to interest science students in doing graduate work towards the Ph.D. on space science topics.

Graduate students performing research in support of the in-house effort, make up 40 percent of the professional personnel working on GISS premises. Research papers stemming from their closely related on-campus work amount to 250 publications out of a total of more than 600 produced by the GISS staff and associates since 1961, or approximately one-third of the total volume of published research resulting from the New York operation. Forty Ph.D. degrees in astronomy, physics, and geophysics have been granted to students associated with GISS through this arrangement.

Discussion. - These facts indicate that the grants to New York area universities are being used in a different way than most of those which support space research out of Sustaining University Program funds. The grants support a group of university personnel who directly participate in the in-house research effort. These university personnel contribute a major share of the research activity and make for fruitful interaction between NASA and universities in the New York area.

Virginia Associated Research Center (VARC) and Space Radiation Effects Laboratory (SREL)

Purpose and description. - The VARC is an arm of the College of William and Mary located in Newport News, Virginia, and, in addition to its educational function, is responsible for administering the contract to operate the SREL. Approximately 50 percent of the time on the accelerators of SREL is for government experiments and 50 percent is for outside organizations.

Authority and example. - The VARC was established by the 1962 General Assembly of Virginia; it was initially staffed and administered by the University of Virginia, Virginia Polytechnic Institute, and the College of William and Mary, and later, the Medical College of Virginia. The Governor of Virginia in 1967 dissolved this VARC agreement and put the administration of VARC under the College of William and Mary alone. The College of William and Mary, under contract NASI-5700 with Langley Research Center, manages, operates, and maintains SREL through VARC.

History and extent of use. - The Virginia Associated Research Center was established with three main functions: (1) to manage and operate NASA's Space Radiation Effects Laboratory, located near the Langley Research Center; (2) to develop a research program in which universities and other research organizations might use the laboratory; and (3) to arrange for a coordinated program of resident graduate instruction under the joint sponsorship of participating institutions. The operation of SREL has helped generate research projects and educational undertakings of a varied and broadening sort; VARC has become a graduate center operating with a combined staff and with its courses and projects fully acceptable by each participating university.

SREL was dedicated at the end of 1965. It is now successfully operational, and its cyclotron is scheduled on a 24-hour day, 7-day week basis.

Discussion. - Although the educational program at VARC has experienced difficulties in the past, it is now in full swing. There are over 400 graduate students from the local area involved in a variety of courses, and 50 Langley employees are taking graduate courses in physics and engineering. The College of William and Mary now offers the Ph.D. in physics and Old Dominion University will offer the Ph.D. in engineering in 1971. William and Mary has recently asked the Virginia Legislature for $887,000 for a new 25,000-square-foot space science building on the VARC site.

Lunar Science Institute

Purpose and description. - The Lunar Science Institute provides a location and facilities for university scientists working in close proximity to the Manned Spacecraft Center, enabling and encouraging a closer working relationship between university and government personnel engaged in lunar science research; it provides a repository of data unique to research on lunar material; and it provides a source of information for scientists and qualified graduate students interested in working on space research.

Authority and example. - The Lunar Science Institute was established in March 1968, based on recommendations of the President of the National Academy of Sciences. The NAS administered the formation, renovation of facilities, and early work of the LSI and maintained administrative control with the assistance of two NASA grants for these purposes. Subsequently, the Universities Space Research Association, a consortium of 50 universities, was formed for concerted action on space research problems and to operate the LSI. Its funds are provided by NASA contract.

History and extent of use. - The staff of the LSI occupied the renovated facilities in October 1969, having previously been accommodated at MSC and in rented space. Formal dedication was held on January 4, 1970.

Discussion. - The Visiting Scientists Program is one of the key operational elements of LSI. The scientists are selected on the basis of their scientific competence and the relevance of their proposed research to the overall LSI program. Six have been selected and appointed to date.

To assist scientists unfamiliar with MSC, LSI and MSC are cooperating in the preparation of descriptive brochures about the facilities and resources available, as well as providing for detailed facilities orientation visits when required.

A lecture program is designed to bring distinguished scholars and researchers to the LSI to share their thoughts and achievements with the LSI/MSC community.

Another function of the LSI is to make its facilities available to provide a suitable academic atmosphere for the conduct of special meetings and conferences by NASA groups or by local and national professional groups.

Environmental Sciences Institute

Purpose and description. - The School of Natural Sciences and Mathematics at San Jose State College established an Environmental Sciences Institute in September 1968; its purpose is the development

of integrated studies in the biological and physical sciences as they pertain to man's environment. Membership is by contribution from individuals, organizations, or graduate students. The projects are generally conducted at the college.

Authority. - Authority for NASA participation is given by 42 U.S. Code 2473 (b).

History and extent of use. - The Ames Research Center is a contributing member ($100 annually), and Dr. John Greenleaf of Ames is secretary of the Executive Council of the Institute.

Discussion. - NASA participation has been minimal so far, but the importance of environmental science to contemporary national goals cannot be overlooked.

Ames-University Coinvestigation in Flight Project Experiments (Consortium)

Purpose and description. - The consortium has been established to perform organic analysis. The consortium is under the direction of an Ames scientist, Dr. C. A. Ponnamperuma. Associated with Dr. Ponnamperuma are six principal investigators in micropaleontology, biochemistry, physical chemistry, and geochemistry.

Ten coinvestigators add competence in organic chemistry, analytical chemistry, and geology.

Authority and examples. - Ames has supported two grants bearing on lunar samples, NGR 26-004-011, Gas Chromatographic Techniques, under the direction of Dr. Gehrke at the University of Missouri, and NGR 05-007-077, Analysis of Ancient Sediments and Extraterrestrial Materials, under the direction of Dr. Kaplan at the Institute of Geophysics and Planetary Physics, University of California, Los Angeles.

History and extent of use. - The principal investigators will perform their respective analytical procedures at the Ames Research Center. Although most of the analysis will be accomplished at Ames, there are two exceptions: Ames does not have the equipment for the isotope fractions studies to be performed under the direction of Professor Kaplan; a minute fraction of the sample and of the extracts from the analytical procedures will have to be examined by using the isotope mass spectrometer at UCLA. The case of the porphyrin analysis is similar. The analytical procedure outlined by Dr. Halpern postulates the need for the measurement of magnetic circular dichroism. A small extract in which porphyrins may be present will be examined at Stanford.

Discussion. - The idea behind the setting up of the consortium for the analysis of lunar samples was to bring together a group of experts of diverse interests in one place to study the samples and to learn as much about them as one possibly could.

CONCLUDING REMARKS

A particular NASA-university relationship may range from a single telephone conversation to the establishment of a new institution. It is probably pointless, if not impossible, to list every different university relationship experienced. But the major classes of relationship have been listed and discussed as examples. This documentation shows that, although only six or eight basic types of instrument, or authority, are used for relations with universities, the diversity of scope and detail in their use is enormous.

A study, a symposium, and a catalog of federal laboratory - university programs and relationships prepared for the Federal Council for Science and Technology (refs. 5, 6, and 7) list only a few relationships that would be new for NASA. These include (1) use of funds from a foundation, or other third party, to pay for released time of NASA staff to teach in a university, (2) use of NASA facilities and equipment by university faculty for teaching their students, and (3) development by NASA of new audiovisual techniques for teaching. There is no administrative bar to any relationship like these; if they have not been used, it is that the need and feasibility have not occurred.

The catalog, (ref. 7) also shows that some federal laboratories have much more movement of personnel between the laboratory and the university than is characteristic of most NASA centers. In fact, some NASA centers have more university traffic than others. The amount of such traffic is set by judgment both by university personnel and by NASA management, and it also reflects the nature of the mission or objectives of a center. University people do isolated, basic research studies well and easily, and so there is extensive collaboration in space science studies and in other specialized research areas where such studies occur. Collaboration is less extensive with NASA centers that are committed to and organized for the development of a field of applied technology and the management of large programs. Exposure of university people to this aspect of modern science and engineering is important, nevertheless, especially if the university is to participate in the continuing education of active scientists and engineers. As can be seen in this report, NASA has mechanisms for such collaboration.

The wide variety of uses to which a relatively few instruments (grant, contract, cooperative agreement, etc.) are put suggests that the needs or desires of the major participants are the key to having a NASA-university relationship. A suitable wedding can always be arranged; one first must find a bride and groom. And, an attractive dowry helps! NASA has broad enough authority in the Space Act and the Training Act to have a very flexible set of techniques for working with universities. Regulations are adaptable enough to allow a mutually advantageous relationship for most situations. But for any relationship to occur, one must first find the individuals in the university and in NASA who are willing to get together and make something happen.

Also, it seems clear that what happens in a NASA-university undertaking depends more on the wishes and predilections of the major participants than on the legal instrument being used. The scope and tone of a NASA-university activity depend largely on the policy or attitude of NASA management, particularly the center management, and on the desires of the university participants. Of course, money, as well as people, is an inevitable constraint.

It follows that, if changes or adjustments are to be made in the ways in which NASA relates to universities, they will have to start with people rather than paper, with ideas rather than instruments, and with resources rather than regulations. If a method for relating to a university in some mutually desired way cannot be found in this catalog, the likelihood is nevertheless good that an appropriate method can be devised within the broad authorities with which NASA acts.

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5. "Education and the Federal Laboratories" Federal Council for Science and Technology. March 1968. Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, Document PB 178018. $3.00.

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APPENDIX A

ENABLING LETTER

May 27, 1969

TO : (Task Group Members)

FROM : Y/Assistant Administrator for University Affairs

SUBJECT: NASA-University Program

I am very interested that we develop and document the methods that NASA and its Centers now use or reasonably could use in relating NASA and Universities in common cause. In other words, what projects, programs, contract methods, grant methods, mutual agreements, mutual understandings, written or oral, have been tried or could be tried in the conduct of NASA-University Affairs to bring professors and students into closer, more productive working relationships with Center personnel.

Dr. Walter T. Olson of the Lewis Research Center has kindly agreed to head-up an effort to assemble and document our experiences and our views as to all possibilities in this area.

With this letter, I am asking you if you will be willing to work with Dr. Olson in this effort. He plans to solicit information from you largely by mail although two or three, one-day group meetings may be required to harmonize a point of view about the undertaking. I am asking you to accept this assignment because it will be necessary to have a representative from each NASA Center who can present what the Center has tried in a concise and knowledgeable manner, and who can comment authoritatively on the strength and weakness and general value of the different university relationships that were tried.

The purpose of the completed study will be to help develop more effective University programs and to assist the Centers in the development of closer working relationships with universities.

When you reply to me, will you please send a copy of your reply to Dr. Walter T. Olson, Assistant Director, Lewis Research Center, so that he may proceed to contact you.

Original signed by
J. G. Pohly
for F. B. SMITH

APPENDIX B

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